

Asymmetries in Union Relative Wage Effects in Ghanaian Manufacturing

An Analysis Applying Quantile Regressions

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Evidence from Ghanaian manufacturing confirms that unions have an asymmetrical effect on wages: they benefit mainly the lower end of the wage distribution. The evidence also confirms the presence of structural differences between union and non-union segments: workers in the union sector of manufacturing earn more than workers in the non-union sector.

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Summary findings

Blunch and Verner analyze the determinants of earnings in Ghanaian manufacturing, focusing on the impact of unions in terms of the “union relative wage effect” and the possible asymmetries of this effect across the earnings distribution.

They find evidence of a union relative wage effect occurring through two distinct channels. First, there is a direct effect through individual union membership, the standard “union premium” well known from the empirical literature on unions. Second, there is a spillover effect to non-union members. The authors also find evidence of an additional union effect that comes through firm-specific training.

They confirm their conjecture that there is an asymmetry in the union relative wage effect: unions benefit mainly at the lower end of the wage distribution. This finding is in line with earlier research, which generally finds that unions reduce income inequality and wage discrimination.

An evaluation of the non-union subsample using the estimated union wage structure confirms the presence of structural differences between the union and non-union segments of Ghanaian manufacturing: for given characteristics, a worker in the union sector earns more than a worker in the non-union sector.

This paper—a joint product of Human Development 3, Africa Technical Families, and the Economic Policy Sector Unit, Latin America and the Caribbean Region—is part of a larger effort in the Bank to understand the links between education, training, earnings, and institutional arrangements. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Melvina Clarke, room G8-118, telephone 202-473-1752, fax 202-522-3252, email address mclarke@worldbank.org. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at nblunch@worldbank.org or dverner@worldbank.org. March 2001. (34 pages)

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Asymmetries in Union Relative Wage Effects in Ghanaian Manufacturing – An Analysis Applying Quantile Regressions[†]

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"I did not begin my research on Ghanaian trade unions with the idea that organized labor could rescue this small, developing West African state from its economic difficulties. But neither did I have the pre-conceived notion, today popular in some quarters, that unions are irrelevant to the struggles of Third World peoples to maximize their own freedom".

Paul S. Gray (1981).

1. Introduction

While the analysis of the determinants of earnings has been one of the success stories in empirical labor economics, less emphasis has been placed on the interplay between wages and institutional factors, such as labor unions, for example. This is particularly true in the case of Sub-Saharan African countries¹, where such analysis seems especially warranted as a basis for policy proposals due to formal sector jobs being scarce and wages generally being low, in turn leading to both poverty and – due to the resulting low tax-revenues - a low level of goods and services from the public sector. The latter precludes promoting education, i.e., building human capital, for the next generation to the extent that is socially optimal.

The experience from developed economies seems to suggest that unions do potentially furnish a mechanism for providing a positive environment by affecting labor turnover and wage negotiation costs adversely, as well as promoting worker training, increased worker benefits and higher productivity, see Standing (1992). Hence, there seems to be a scope for investigating the earnings determinants for developing economies with a focus on the possible effects of unions in greater detail, including a study of possible asymmetries across the earnings distribution.

¹ See however, Rama (1998) who analyzes West-African CFA (Communaute Financiere Africaine) countries and finds evidence of unions in the private sector being more instrumental in creating wage moderation than in creating wage drift in CFA countries. Their members usually get lower wages than similar nonunionized workers, which the author ascribes to the subordinate nature of the labor movement in CFA countries. Kristensen and Verner (1999) analyze labor market distortions in Côte d'Ivoire and find evidence of unions affecting wages adversely at the higher quantiles of the earnings distribution, which seems to agree with the findings of Rama (1998). Schultz and Mwabu (1998) analyze labor unions and their impact on wages and employment in South Africa. Among the main findings are that wages of union members of young African male workers are 145 percent higher than comparable nonunion workers in the bottom decile of the distribution and 19 percent higher in the top decile of the wage distribution. It is estimated that if this large union relative wage effect were cut in half, the employment of African youth, between the ages of 16 and 29, would increase by two percentage points.

This paper analyzes earnings determinants in the Ghanaian manufacturing industries (food, wood, metal and textile), focussing on the impact of unions and the possible asymmetries of this impact across the earnings distribution. The channels through which we conjecture a potential union effect are twofold. First, we propose a direct effect through individual union membership. This is the standard “union premium” well known from the empirical literature on the so-called “union relative wage effect”, emerging with Lewis (1963). However, this does not take into account the possible spillover to non-union members from unionism. To incorporate a potential spillover effect, we allow unionism to potentially affect all workers, including a sectoral union density variable. In addition, we examine whether there may be an additional union effect coming through via training, as proposed by, e.g., Booth and Chatterji (1998) and Booth, Zoega and Francesconi (1999), since the union may promote training to a degree over and above that of management, due to, e.g., unions having a longer time horizon than management, which may merely maximize profits and stock values in the short term. We conjecture that the union effects are more likely to be present at the lower to medium quantiles of the earnings distribution, since unions are generally seen as – and perceive themselves as – proponents of workers’ rights and earnings for the poorer part of workers. Such a view would also be in line with previous research, which generally finds that unions reduce income inequality and wage discrimination, e.g., Panagides and Patrinos (1994).

While being of academic interest due to the relative skewness in earnings determinants studies since the majority of studies concern developed economies, and furthermore do so for the entire wage distribution, there are important policy issues involved as well. If unions affect wages positively, through the channels defined and discussed above, then unions should not necessarily be seen as obstacles to economic recovery of developing countries. Indeed, unions may even promote a positive environment by affecting labor turnover and wage negotiation costs adversely, as well as promoting worker training, increased worker benefits and higher productivity, see Standing (1992).

The main finding of the paper is a finding of distinct asymmetries in the effects of unions across the wage distribution. The findings are consistent with a prior belief that unions mainly bargain on behalf of the workers at the lower end of the wage distribution.

Further, we find, in addition to a direct union premium related to individual union membership, an additional spillover effect to non-union members, coming through via the degree of unionization of the sector. Lastly, we find an additional indirect union effect coming through via training, interpretable as unions promoting training and being able to bargain and subsequently share some of the rents obtained by firms with their members. While unions generally have only a short and controversial history in Sub-Saharan Africa, due to the continent relying heavily on smallholder agriculture in addition to the fact that unions are often prohibited by the national governments, the findings of this study indicate a role for unions in Ghana as being an effective “voice” for workers, and, possibly, also promoting training and efficiency in terms of lowering turnover and negotiation costs between workers and management (the data does not allow a rigorous investigation of this latter issue, however). Lastly, evaluating the non-union sub-sample using the estimated union wage structure, i.e., “*as if*” it was unionized, further establishes the presence of structural differences between the union and non-union part of the Ghanaian manufacturing industry in that for given characteristics, a worker in the union sector earns more than a worker in the non-union sector. This finding implies the existence of structural differences between the union and non-unionized part of the manufacturing sector, i.e., that unions do affect wages positively, which further corroborates the previous findings.

The paper is organized as follows. The next section discusses the economic theory underlying the analysis of trade unions, as well as a brief overview of the history of unionism in Ghana. Then follows in section three a discussion of the methodology of this paper, including the economic model, the econometric framework and data issues of this study. An explorative descriptive analysis of the data set is performed in section four, which is then followed by the quantile regression analysis in section five. Section six concludes and gives directions for further research.

2. The Economics of the Trade Union and Empirical Evidence

In this subsection we review the theoretical framework for the analysis of the trade union and provide a brief overview of the history of unionism in Ghana.

2.1 Theoretical Analysis of the Trade Union²

A natural starting point in the analysis of unions would be to ask: “what do unions do?” (Freeman and Medoff; 1984). The answer to this question is not straightforward, however. The theoretical literature traditionally states two main objectives of the union, namely to maximize (1) employment, and (2) wages of union members. Hence, here already we see that the answer to “what do unions do?” is not clear-cut. Indeed, there is an obvious trade-off at work between union objectives, since higher wages would seem to bring about higher unemployment and vice versa, *ceteris paribus*³. These objectives have traditionally been taken as exogenously given in the literature, although some attempts have been made to introduce endogenous elements. Most notably, the level of union-membership has been argued to be an endogenous component of the union’s objective function, due to unemployed members possibly leaving the union, see Pencavel (1991).

As a consequence of the union objectives as stated above, it follows that for the forming of a union to be possible (unless maximization of members’ employment were the exclusive objective), there must exist some rents in the product market(s) that can be shared between the firm and the union, and, ultimately, the workers (note how this seems to contradict the implication of perfect competition, under which a given firm earns zero profits – or, alternatively, the firm’s production function exhibits decreasing returns to labor in a neighborhood around the equilibrium⁴). However, there may be a case for the existence of unions generating the rents, which are subsequently shared with the union members – this is something that we will return to later. Second, the union must have some bargaining power that enables it to obtain part of these rents. When the union, i.e. group of workers, is large or strong enough that a threat of strike is credible, it will have the bargaining power that is necessary, but not sufficient, to obtain rents. In addition, namely, it is required that there be no or only minor alternative, i.e., unorganized, labor available. Hence, the union must have some degree of monopoly power in the supply of labor. Ultimately, when an entire sector is organized, a “closed shop” arrangement is said to be effective in the sector in question.

² This sub-section relies heavily on Booth (1995).

³ Naturally, the tradeoff depends on the elasticity of the demand for labor in the sector of interest: the more elastic is labor demand, the larger the “price” in terms of increased unemployment for an increase in wage demands. Similarly, the more inelastic is labor demand in a given sector, the smaller the loss in terms of unemployment.

⁴ See Ulph and Ulph (1990).

Once in place, the existence of the union has several potential effects. First, the union may impose allocative costs through the distortion of factor prices, coming about through the increase of wages over and above what they would otherwise have been. In the absence of unions, allocative efficiency comes about as an allocation of identical factor inputs such that their marginal products are equalized across sectors. However, when unions are present, the wages of the unionized sector(s) is higher, relative to the non-unionized, which, in turn, leads to an employment level in the unionized sector below what it would otherwise have been. Next, this results in an influx into the non-unionized sector of formerly organized workers, in turn adversely affecting the wages in this sector.

Unions may also bring about technical inefficiencies. This is so, since in addition to the level of wages, the unions may also affect the restrictive practices of an industry, such as manning agreements or rules about work pace. Additional adverse effects on output may come about if the strike threat is actually carried out (and substitution with non-organized labor is not possible or limited).

Note, however, that while the above discussion implicitly assumes perfect markets (prior to the emergence of the union), there exist considerable evidence that many product markets are characterized by imperfect competition, arising from bargaining power of labor due to specific training, mobility costs, and/or hiring and firing costs. For example, Stewart (1990) finds in an analysis of British data that only five percent of the establishments for which there is a positive and statistically significant union-non union wage differential operate in competitive product market conditions. In this case, it is not certain whether the replacement of individual bargaining with collective bargaining will bring about additional inefficiencies or, rather, *reduce* the preexisting inefficiencies. This brings us to the second of the “two faces” of unionism, in Freeman and Medoff’s (1979) terminology: there is a potential for *positive* effects coming about as a consequence of unionism. Hence, rather than merely obtaining part of an already existing surplus, a union may be able to *generate* a surplus. First, it may act as an information provider, sharing information on workers’ preferences for wages, personnel practices and so on between workers and management, information which may not otherwise have been shared. The reason for this is that while each individual may fear retaliation from management from expressing an opinion, a collection of workers - in a union - may not. Hence, the union

may act as the workers' "voice", Hirschman (1970). Second, the existence of unions may work as a "pool" of labor, in turn resulting in lower turnover and negotiating costs, since management now only needs to employ centralized bargaining, which is less costly than bargaining with each worker individually. Obviously, a crucial factor in a union's recognition as an efficiency-enhancing factor will depend on the extent to which continuity in the employment relationship is desirable.

In particular, it has been argued that union organization is more likely, the more workers are trained in firm-specific skills, see Williamson (1985). In this case, the worker and the firm share the costs of capital-accumulation and both are similarly interested in maintaining a long-term relationship in which the returns from the human capital investments can be enjoyed, see Becker (1962). Booth and Chatterji (1998) analyze the optimal level of training, when training comprises both general and firm-specific elements in a theoretical model. They find that the existence of local union-firm bargaining ensures that the post-training wage is set sufficiently high so as to minimize the number of quits considerably below what it would be in the absence of unions, in turn increasing the level of training provided by the firm. This analysis is consistent with the stylized fact that unions are associated with lower turnover and more-firm provided training, see, e.g. Booth, Zoega and Francesconi (1999). Hence, in addition to a direct wage effect coming through via unions' bargaining power, we may a priori expect an additional effect from unionization coming about via (firm-specific) training. An investigation of whether this lends support to the Ghanaian experience, will be one of the main topics of the empirical analysis below.

The discussion above is what underlies the notion of the so-called "union relative wage effect", originating with the seminal work by Lewis (1963). Lewis defines the union-nonunion wage differential ("the union relative wage effect") as:

$$r_i = \frac{W_i^u - W_i^n}{W_i^n} \quad (1)$$

Hence, referring to the above discussion, the possible existence and magnitude of the wage differential will depend on the extent to which the union is able to affect the wages of members relative to the wages of nonmembers, e.g., through bargaining, at one

extreme, where the union through its bargaining power merely extracts and subsequently shares already existing rents (in the form of profits) of the firm with its members, to the other extreme, where the union generates rents through its potential adverse effects on labor-turnover and costs of wage-negotiations between management and workers (in reality, however, rather than any one of these two “pure” cases, it is likely that what we will see in reality is a *combination* of these two effects). However, as to the exact *empirical implementation* of this notion of a union relative wage effect, the theory is silent. This is left to the researcher, and there are several possibilities, with their advantages and disadvantages, as we shall see in the discussion on econometric methodology below.

2.2. A Brief Overview of the History of Unionism in Ghana

Most Sub-Saharan economies are dominated by smallholder agriculture, which, combined with the fact that many Sub-Saharan African governments historically have effectively prohibited independent trade unions, has led to unionism being low or even absent in many countries of the continent. Ghana, however, has a long tradition for labor unions, originating with the many guilds and artisans’ associations in the early nineteenth century in what was then the Gold Coast, Gray (1981). The origin of guilds and artisans led naturally to an organization of labor according to the field of work, e.g., into industrial and commercial workers, mineworkers, public service workers, teachers and educational workers, maritime and dock-workers, and so on, just as is common in most developed economies. The potential synergies between the labor movement and government were already realized early, even before Ghana’s independence in 1957. In 1930, Lord Passfield (Sidney Webb) noted in a dispatch that “regulation of wage laborer organizations was of importance, and that colonial governments should act to facilitate the passage of unions into constitutional channels”, Gray (1981).

This early sign of recognition and potential desirability of more organized labor organizations was further strengthened following the cocoa boycott in 1937-38, which led to the forming of the Department of Labor – clearly a sign of the initial importance given to labor issues in Ghana. With the enactment of the Trade Union Ordinance in 1941, unions got the first official endorsement. Being the Ghana-specific part of the more general (in a geographical sense, being for *all* the British colonies) Colonial Development Act from the year before, this ensured that Ghana (just like any other British territory)

could not receive help under the law unless it had in place legislation, which protected the rights of trade unions. A major driving force behind the 1941 law, according to Gray (1981, p. 14) was an “unmistakable desire of the British to build up the unions and to use them in order to rationalize labor relations, reduce strikes and absenteeism, and increase efficiency”. Clearly, these points accord well with the (potential) workings of unions, which have become a standard part of the theoretical literature on unions, as discussed in the previous discussion.

The seminal legislation fused a rapid growth of labor organizations in Ghana: by the end of 1942, four unions had been registered – by 1946, this number was increased by another twenty unions. In 1945, 14 of these unions were gathered in the Gold Coast Trade Union Congress, known as the TUC, accounting for around 5,000 of the organized labor in Ghana, a number which subsequently increased rapidly (to almost 11,000 the year after). This has since been expanded with numerous unions formed by the employees of several government departments and private enterprises and is today the mother organization of Ghanaian trade unions.

Following the increase in trade unions and the increased pressure on employers, employers also started to organize themselves, “it is significant that the earliest permanent employers’ group, the Chamber of Mines, appeared in an industry with a strong union”, Gray (1981). Hence, it may be claimed that the emergence of unions helped generate a more dynamic environment on the labor market, where management and workers could meet and exchange ideas, thus increasing efficiency in production. The formation of the first umbrella organization of employers came with the inauguration of the Ghanaian Federation of Industries, which later led to the founding of the larger and more permanent organization, The Ghana Employers’ Association (GEA) in 1959. The GEA and the TUC were mainly brought together by collective bargaining, but later they expanded their relations and activities, meeting to discuss problems of development and additional ways of future cooperation. A very concrete example of the developing relations between workers’ (TUC) and employers’ (GEA) organizations is the Labor Advisory Council, which was a body specified in both the 1958 and 1965 labor laws. The Council was originally created to advise the Department of Labor and became a very important forum for exchanges between management and unions, both of which had an equal representation of seven members in the Council.

The Industrial Relations Act of 1958 was a major breakthrough for the organization of labor. It secured bargaining guarantees for the unions in that it allowed extension of collective agreements, by administrative action, to workplaces where employees do “the same kind of work” as those already covered by agreement, but whose employers were reluctant to negotiate, thus, in effect, “forcing” reluctant management to the negotiating table or, if not, at least to acknowledge existing agreements. Notably, the effect is very clear in the data. Considering data from 1959 to 1977, Gray (1981) notes that the number of new agreements signed increased dramatically following The Industrial Relations Act of 1958. Starting with 3 new agreements signed in the period 1959-60, in 1977 the number of new agreements signed was 57 (with a peak of 66 in 1976). Similarly, the number of total agreements in force exploded as well. Starting with 21 in 1959-60, the number of total agreements in force increased to 180 in 1977.

So what has been the effect of the increase of unionism in Ghana? Gray (1981) suggests that unions have been helpful in decreasing the number of strikes. Analyzing data on the number of work stoppages and man-days lost from 1945 to 1976, Gray finds that “against a background of increasing union membership, the number of strikes is remarkably consistent and, in fact, surprisingly low, given the rising worker expectations prior to independence and the unstable economic conditions after 1965”. This points towards unions having played an active and positive role in the economic development of Ghana.

Following the economic breakdown of the Ghanaian economy in 1983, the so-called Economic Restructuring Program (ERP) was initiated by the Ghanaian government in collaboration with the IMF and the World Bank. One of the measures taken was a permanent layoff of 20,000 public workers from the “notoriously overstaffed Cocoa Board”, Nelson (1991), which was however, followed by an equivalent of roughly two years’ total compensation. Note that this seems to indicate a concern of wages over employment, at least for public workers’ unions. This conclusion seems in line with the events in 1986, where the government announced an abolishment of leave allowances, which was a benefit that substantially supplemented low public-sector wages. Unions threatened with strikes, leading to the government reversing its decision and revising the 1986 budget, so that the allowances were no longer abolished. Also, between 1984 and 1991, the minimum wage had risen by more than 1200 percent as a result of bargaining

between TUC, GEA and the government. All of these events hint at the bargaining power of Ghanaian unions being substantial.

There are examples of an even more active and direct influence of unions in Ghana. Vormawor and Awuku-Apaw (1996) report a program run by The General Agricultural Workers' Union (GAWU) in small villages in the Greater Accra Region in which rural workers have been organized into farming units and provided with education on issues such as grain storage, community afforestation, bee-keeping and the processing of gari (a local staple food). As a second example of non-traditional union roles, the GPRTU, which is comprised of commercial vehicle owners, drivers and their assistants, is responsible for vehicle safety and the collection of taxes for local and other government agencies, as well as checking over-speeding and the use of fire extinguishers by drivers. Further, they help financing vehicles for members, Panford (1998). All of this implies that the workings of Ghanaian unions may potentially go above and beyond the "traditional" wage/employment bargaining, affecting the wider economy, including the environment (however, the dataset applied in this paper does not allow us to go further into non-pecuniary issues of unionism in Ghana).

3. Methodology

This section presents a discussion of methodological issues involved in this study. We start with a discussion of the economic model underlying the analysis, and then discuss how to estimate this model, specifically aiming at incorporating the possibility of a union relative wage effect. Lastly, we discuss data related issues, focussing on how to incorporate unionism as an explanatory variable in the analysis of wage determinants.

3.1 Economic Model

The theoretical framework for the analysis is standard human capital theory; see, for example, Becker (1975) and Mincer (1974), where an individual builds up knowledge and skills via education and experience (specific on-the-job, as well as general experience). According to the theory, individuals are then subsequently rewarded in terms of higher earnings according to the level of accumulated human capital. Formally,

the economic model may be derived from the theory of individual demand for schooling, which viewed education as an investment in human capital, Becker (1975).⁵

Following this view, an individual will invest in education up to the point where the marginal benefit from an additional year of schooling equals the marginal cost of an additional year of schooling⁶. In the traditional human capital literature earnings are determined by education and other individual characteristics. However, since our dataset allows inclusion of union and firm level variables as well, the standard Mincerian earnings function is augmented with union and firm level characteristics, resulting in the following simple model:

$$W_i = W(I_i, F_i, U_i) \quad (2)$$

where W (wages) of individual i is the dependent variable, I is a vector of individual characteristics; for example age and age squared, the latter to capture possible non-linearities, proxying general experience; tenure in the firm, capturing firm-specific experience; the level of education and gender. F is a vector of characteristics for the firm of individual i , for example the size of the firm (proxied by the number of employees) and geographical location. U is a vector of variables capturing possible union effects for individual i , for example union membership and/or union density of the firm or the sector.

3.2 Econometric Framework

The estimation method applied in this paper is quantile regression analysis. This method allows the marginal effects for different quantiles (where the quantile of interest may be chosen arbitrarily) of the dependent variable to be estimated simultaneously, thus exploring the entire conditional distribution. By allowing the parameter estimates for the marginal effects of the explanatory variables to differ across the quantiles of the

⁵ While for developed economies the investment decision may be viewed as a decision of the individual due to the existence of widespread subsidies to education and relatively less pooling of resources, for developing economies the relevant decision unit may be the household. However, we will not go into these issues in this study. See Khandker, Lavy and Filmer (1994) and Mason and Khandker (1997) for a detailed description of a household decision model.

dependent variable, robustness to potential heteroscedasticity is achieved as a result. This contrasts with the widely used Ordinary Least Squares regression, which requires homoscedasticity (indeed, in the bulk of the empirical literature, the presence of homoscedasticity is merely a maintained hypothesis).

The method, however, has virtues other than being robust to heteroscedasticity,. When the error terms are non-normal, for instance, quantile regression estimators may be more efficient than least squares estimators. Furthermore, since the quantile regression objective function is a weighted sum of absolute deviations, one obtains a robust measure of location and, as a consequence, the estimated coefficient vector is not sensitive to extreme observations on the dependent variable. The main advantage, though, is the semi-parametric nature of the approach, which relaxes the restrictions on the parameters to be constant across the entire distribution of the dependent variable. For our purposes, in particular, we would a priori expect the union relative wage effect to differ across the wage distribution, since unions would seem to be bargaining mainly on behalf of the workers at the lower end of the wage distribution. Further, it seems likely that the returns to education, tenure, or other relevant observable variables would differ across the wage distribution. For example, we may conjecture that education will be a more important determinant at the higher quantiles, relative to the lower quantiles.

Formally the method, first developed by Koenker and Basset (1978), can be formulated as:

$$Y_i = X_i \beta_\theta + u_{i\theta} = \text{Quant}_\theta(Y_i | X_i) = X_i \beta_\theta \quad (3)$$

where $\text{Quant}_\theta(Y_i | X_i)$ denotes the θ^{th} conditional quantile of Y given X for individual i.

In general, the θ^{th} sample quantile ($0 < \theta < 1$) of Y solves:

$$\min_{\beta} = \frac{1}{n} \left\{ \sum_{i: Y_i \geq X_i' \beta} \theta |Y_i - X_i' \beta| + \sum_{i: Y_i < X_i' \beta} (1 - \theta) |Y_i - X_i' \beta| \right\} \quad (4)$$

⁶ This implicitly assumes perfect information of the household decision maker, as well as perfect capital markets, both of which are very restrictive and, likely, unrealistic assumptions in the case of developing

Buchinsky (1995) examines various estimators for the asymptotic covariance matrix and concludes that the *design matrix bootstrap* performs the best. In this paper, the standard errors are obtained by bootstrapping using 200 repetitions, in line with the literature.

In addition to the quantile regression analysis, we will also estimate the mean logarithmic union-nonunion wage differential (or, similarly, the wage gap). Following Hirsch and Addison (1986), the wage equation is estimated for the union⁷ and non-union sector separately, thus estimating:

$$\ln W_i^n = X_i^n \beta_n + \varepsilon_i^n \quad (5)$$

$$\ln W_i^u = X_i^u \beta_u + \varepsilon_i^u \quad (6)$$

where subscripts n and u indicate the “non-union” and “union” sectors, respectively. The mean logarithmic union-nonunion wage differential (or, similarly, wage gap) is estimated as:⁸

$$\bar{d} = (\beta_u - \beta_n) \bar{X} \quad (7)$$

The wage differential may be evaluated at either the mean characteristics of the workers from the union or non-union sub-sample or from the full sample. We choose to evaluate the wage gap/wage differential at the mean characteristics of the full sample, since this, in effect, amounts to asking: “What is the predicted wage differential between working in the union and non-union sectors for a worker with average characteristics?”, Hirsch and Addison (1986).

economies.

⁷ We define the union sector as the collection of firms, for which at least one worker is a member of a union. Similarly, the nonunion sector consists of all firms, where no workers are organized in a labor union. Had we conditioned on individual union membership instead, we would implicitly have assumed no spillover effects to the wages of non-union members (at the firm level – note that since there are organized workers in all four sectors, we cannot use the sectoral union density variable to discriminate between the union and non-union sectors since then, in effect, we would operate with the union sector, *only*).

⁸ The wage gap may be converted into a percentage value by applying the formula:

$$\text{wage gap in percent} = (1 - e^{\bar{d}}) \cdot 100$$

where e is the exponential function, see Halvorsen and Palmquist (1980).

Next, we may test whether the union relative wage effect is statistically significant by combining the estimated union wage structure and the characteristics of non-union members, hence estimating:

$$\ln \hat{W}_i = X_i^n \beta_u \quad (8)$$

i.e., the wages of non-union members are predicted “*as if*” they were subject to the estimated union wage structure, i.e., to the returns to individual and firm characteristics prevailing in the unionized sector. Once estimated, we may then test whether the predicted wages from (8) are statistically different from the actual wages of non-union workers using a standard t-test. We will take rejection of the null-hypothesis of equality of the two wage series as implying structural differences between the union and non-unionized part of the manufacturing sector, i.e., that unions do affect wages positively.⁹

3.3 Data Issues

The data are from the Regional Program on Enterprise Development (RPED), a survey carried out by the University of Ghana, the Centre for the Study of African Economies (University of Oxford) and the Overseas Development Administration (London) in collaboration with the World Bank in 1994. The survey covers 215 firms in Ghanaian manufacturing (consisting of the four sectors wood, food, metal and textiles), from each of which a sample of up to ten workers were interviewed, leading to a total sample of 215 firms and 1206 workers (however, there is a substantial dropout due to missing observation, leading to an effective estimation sample of 683 workers).

The main variables of the survey applied in this study include a “core” of (log) monthly wages and the standard human capital variables: age (to capture potential general experience), tenure in the firm (to capture potential specific experience), highest level of education, training variables, as well as occupational control variables and firm

⁹ Our alternative hypothesis is

$$\ln \hat{W}_i > W_i^n$$

This yields a test with more power than the two-sided alternative.

level control variables, most notably size¹⁰ of the firm in terms of employees. Regarding the issue of the possible existence of union relative wage effects, as discussed previously, this may be measured in various ways. There are two dimensions involved here. First, how do we conjecture the channel through which the union impacts wages: is there an individual, direct effect through individual union membership (the approach taken in, e.g., Beaudry and Sowa (1994) or is there instead (or potentially) an indirect effect through the degree of unionization at an establishment or in an industry (this is the approach taken by, e. g., Maloney and Ribeiro; 1999), as this is viewed as proxying the bargaining power of a union within an industry, thus allowing spillovers to non-union-members? (if such spillovers exist, and are not taken into account, it will likely lead to an upwards bias in the estimated premium to individual union membership). We choose to let this be an empirical question (this was suggested to us by Donald Parsons), thus including both a dummy variable for individual union membership, as well as a sectoral union density variable, noting that collinearity is *not* likely to be a serious problem, as these two union variables are only weakly correlated (having a simple correlation of 0.08, whereas the individual union membership and firm union density variables have a simple correlation of 0.76, hence including both of the latter in the same regression would potentially cause serious collinearity problems¹¹).

However, potentially there may still be an endogeneity related to the use of the variable of individual union membership. Following the approach taken in Schultz and Mwabu (1998) we will suffice it to say that it is beyond the scope of our data to endogenize union membership, including explaining who gets a union job and who does not, as well as the extent to which unions enhance the productivity of workers with the same observable characteristics. As a result, any estimated union relative wage effects may overstate or understate the “true” union relative wage effect.

In the other dimension is the issue of how to define the unionized sector. One approach has been to simply measure the impact of unionism at the mean of the

¹⁰ It appears to be a well-established fact that larger establishments pay higher wages than smaller establishments, *ceteris paribus*; see, e. g., Schaffner (1998) and Velenchik (1997).

¹¹ Maloney and Ribeiro (1999) suggest including the union density variable at the *firm* level as a proxy for the bargaining power of the union over the firm’s rents. However, with a high correlation between this and the dummy variable for individual union membership, inclusion of both would likely yield problems with multi collinearity, and hence, it is not valid to simultaneously “allow” the two different channels of a union

characteristics of the sample, i.e. by merely including a dummy variable for whether an individual was unionized or not, and then interpret the possible significance of the parameter estimate of this as a union premium. This approach is not entirely unproblematic, however. The omission of any variables influencing wage determination that are positively (negative) correlated with the union variable will cause the estimated coefficient on the union variable to be upward (downward) biased, since the estimate coefficient picks up the effect from the omitted variable/factor, as well.

For example, we may conjecture that non-union jobs are typically found in smaller establishments/sectors, since it takes a certain size for an establishment or sector to be “interesting” for a union, in terms of potential members. Hence, failure to control for firm size may cause upwards bias in the union premium (however, the present dataset allows us to incorporate firm size as an explanatory variable). Further, in line with our previous discussion, it may be conjectured that firms that have become unionized respond to unionization by carefully vetting prospective new workers in order to employ higher quality workers even more so than before, due to the increased wage demands. And since “quality” is unmeasurable, we may, again, get upwards bias in the union premium estimates. The same applies to the labor turnover argument of unions: if unions reduce labor turnover, and this effect cannot be directly observed and/or included as an explanatory variable, the result is, once again, upwards bias in the union premium estimate.

One solution, if having a panel data set, is to extract the individual fixed effect of the data, thus mitigating the potential bias. If, however, one has a cross-section data set (as we have), an alternative to letting the union effect be captured by a dummy variable in an estimation for the full sample is to split the sample in two, thus estimating the marginal returns to the explanatory variables in the union and non-union sector separately and calculating the union premium as the differential between these two sets of estimates, evaluated at the mean of the sample. For completeness, and since the former approach has been widely used in the literature, we will pursue both approaches in our analysis.

relative effect (direct/individual and indirect/spillover, respectively) that we propose. This is the reason behind our estimated model taking the form it does.

4. Descriptive Analysis

In this section we will perform a very brief descriptive analysis of the data set. This is mainly so as to motivate the more rigorous econometric analysis in the next section.

Turning first to (log) wages, we note from the table in Appendix B that the mean of wages in the non-union sample (as defined in the previous discussion, see above) is lower than that of the union subsample, pointing towards unions being a major component in the wage determination process, possibly through bargaining over firm rents and/or through adversely affecting labor turnover and wage negotiating costs and increasing productivity, as previously discussed. Further, we note that the wages of the union subsample fluctuates less than that of the non-union sector, in line with previous research finding that unions tend to generally decrease wage inequality, Standing (1992).

Somewhat puzzling, 16 percent of the union sample consist of managers, while this is only 8 percent in the non-union sample (as compared to 12 percent in the full sample). While production workers seem to be more represented in the non-unionized sample (63 percent vs. 42 percent) the opposite is the case for administrative staff, where in the non-union subsample 17 percent are from this occupational category, and only 9 percent in the non-unionized sample. While one may a priori expect the production workers to be the most heavily unionized occupational category, we know from the review of unionism in Ghana in section 2.1 that unionism is widespread across virtually all occupations and sectors.

Surprisingly, most of the sample as well as the two subsamples has a permanent contract. Hence, including this as an explanatory variable may a priori appear fruitless due to the low variation in contract status. However, there may be a possibility of an *indirect* effect coming about via training, hence we propose interacting the variable for contract status with training (and since only around 30 percent of the sample has both a permanent contract and received training, this will likely yield some explanatory power due to the higher variation in this interacted variable).

A substantial fraction, 30 percent of the workers, are members of a labor union, so there is at least a potential of discovering a union relative wage effect coming through via individual union membership. Turning to the unionized sub-sample, we note that 60 percent of the workers of unionized firms are members of a union, leaving 40 percent of workers in the unionized sector as not being members of a trade union. The latter would

seem (since 40 percent is a substantial fraction) to make a case for investigating whether there is a spillover effect to wages of non-organized workers in the unionized sector, also. This issue is further explored in the econometric analysis of the next section.

In addition to this more descriptive evidence of possible structural differences between the union and nonunion sectors, we also provide a more rigorous test of whether such structural differences exist. This is done by applying the Mann-Whitney test for equality of two distributions, here, the union and non-union subsamples. For the vast majority of the variables, equality of the distributions of the union and non-union samples can be rejected. This points towards the existence of strong structural differences between the union and non-union part of the Ghanaian manufacturing sector. In turn, this motivates the more rigorous econometric analysis of union relative wage effects in the next section.

5. Union Relative Wage Effects and Union Membership in Ghana: Findings from the Econometric Analysis

In this section, we present and discuss the main findings of the empirical analysis. Our main focus is on union relative wage effects (see the Appendices for a complete presentation of all the findings).

Analysis of Wage Determinants, Full Sample with Union Dummy and Density Variables Included

The first specification allows simultaneously for the union relative wage effect coming through via two distinct channels, namely individual union membership and sectoral union density, the latter allowing for a possible spill-over effect to non-members. The first thing we note is the very strong difference between the OLS and the quantile findings, see Appendix C1. Whereas the concave shape of the life-earnings profile that is, by now, considered a stylized fact in the literature, is apparent in the OLS findings (since, although the quadratic term is “zero” for practical purposes, it is statistically significantly different from zero, due to an extremely low standard error on the estimate) this is not so when considering the quantile regression findings (although the age term is borderline significant for the median regression).

A second important discovery is the overwhelming statistical significance of *all* of the educational dummies when considering the OLS-regression findings. This contrasts with the quantile regression findings, which reveal that for the lowest quantile, there is no premium for education, except for professional education. The number of statistically significant educational earnings premiums increase when moving up along the earnings distribution, which seems in line with a conjecture of education being more important for the individuals in the higher end of the earnings distribution, since these jobs often times require more academic skills than the (often unskilled) jobs at the lower end of the earnings distribution.

Firm size consistently affects wages positively, both in the OLS-regression as well as in all the quantile regressions.¹² An explanation for this could be an efficiency-wage argument, coupled with the monitoring costs of larger establishments, according to which higher wages leads to workers using more effort. And, since the costs of monitoring workers would seem to be larger, the larger the establishment, this effect should increase with firm size, as well.

There do not seem to be any substantial direct effects from tenure or from having a permanent contract, the latter being in line with the fact that the number of workers in the formal sector in Ghana is quite small, hence workers do not require compensation for permanent employment, they merely want to obtain formal sector employment in the first place. Also, the impact from training is negative. One interpretation is that workers carry the cost of the training themselves, and then later may receive a return from the investment (however, we cannot determine the timing of training and hence a possible future positive impact on earnings from the data alone).

However, there is a positive and statistically significant effect coming through from being both on a permanent contract *and* having been trained in the firm. This seems to indicate that once a worker is on a permanent contract *and* the firm has considered it “worthwhile” to let the worker undergo training, then there is a positive return. An interpretation of this is that the prospect of the returns from the investment in training being shared by the worker and the firm in the future (due to the permanence of the

¹² This is in line with previous research, e.g., Schaffner (1998) and Velenchik (1997), who both find evidence of larger establishments paying higher wages, *ceteris paribus*.

contractual relationship¹³) leads the firm to carry some of the costs, i.e., changing the premium from being negative to being positive.

Moving to the findings that represent our main interest, we note the strong asymmetry in the union premium. The direct effect, coming through via union membership of the individual, is positive and significant for only the lower part of the distribution, confirming our conjecture that unions are mainly the “voice” for the workers at the lower end of the earnings distribution, typically low skilled workers. In addition to this, there is an extra union membership effect coming through via training. This seems to indicate that unions increase training, or, at the least, the returns to training. This finding is in line with, e.g., Booth and Chatterji (1998) and Booth, Zoega and Francesconi (1999). The union density of the sector does not seem to influence wages directly, indicating lack of a direct spillover effect to non-union members. However, there seems to exist an indirect spillover effect, coming through via training: when the worker is trained, the degree of unionization in the sector affects individual wages positively, hinting at unions’ bargaining power being able to extract some of the rents from training from the firm and subsequently sharing it with members. This effect persists at the higher end of the wage distribution, as well. Note that had we relied on the OLS-estimates only, we would have concluded the presence of only the indirect spillover effect, and thus, no direct effects from union membership. Clearly, this finding substantiates the importance and potential power of the quantile regression approach as an alternative, or, at least, a complement to the more traditional OLS-based analysis. From the t-tests of equality of coefficients across quantiles in Appendix D, we note that the hypothesis of equal coefficients is rejected for several of the variables. Once again, this points towards the appropriateness of the quantile regression approach.

Analysis of Wage Determinants for Unionized And Non-Unionized Forms Separately

As noted in the earlier discussion, there are potential problems with the above approach. It can lead to bias, and, hence, lead to invalid conclusions with respect to the potential

¹³ Note that this would hold even in the case of an informal contractual relationship, in which the terms of the contract will never be legally enforced. This is so, since even an implicit contract will generally be adhered to by the parties, due to norms, social conventions of the society, and so on. Hence, the actual terms of the contract are not necessarily of relevance per se. This was pointed out to us by Donald Parsons in a private discussion.

impact from unions in terms of a “union relative wage-effect”. One way of dealing with this is to estimate the regressions for the union and non-union sectors separately *if the data so allows*: previously, it was rather unusual to have matched employer-employee data sets. Hence, when estimating the regression for the “union sector”, one had to condition on individual union membership, hence the resulting two estimation samples would be of union and non-union members rather than the union and non-union *sectors*. Again, this implicitly omits any potential for a spillover effect to non-union members, and thus, would likely lead to an upward bias in the estimated union premium. Since we have firm data also, we split the sample into unionized and non-unionized *firms* (since all of our four *sectors* have some union members, we cannot split across this dimension). To operationalize this, we let a firm be in the unionized sector if it had at least one worker that states individual union membership, otherwise they were taken to be non-unionized. Hence, we allow for spillover effects to non-union members within the firm. Again, the findings from these regressions are too numerous to go through in detail so we will, again, highlight the most important findings; see Appendices C2 and C3 for the full results.

The first thing that begs recognition is the difference in the relative importance of the education variables as a wage determinant. In the non-unionized sector, education (apart from professional and university education) seems to be generally less important as a wage promoting factor, whereas formal education is a very important wage generating factor in the unionized sector, especially at the medium to high quantiles. One interpretation of this is that unions manage to force management to acknowledge formal education, possibly to an extent that may be out of line with productivity (judging from the fact that education has virtually no role to play in the non-unionized sector, i.e., in the absence of unions). However, it might equally well be a result of unions being able to extract and share the rents with members, with relative weights according to their educational levels, since in the absence of unions, workers are likely to be weak and without the bargaining power necessary to voice their demands.

Another thing to note is the fact that discrimination (favoring male workers) while being present in the non-unionized sector - as indicated by the strong significance of the gender dummy at the low and middle quantiles - is virtually absent in the unionized sector, since the gender dummy is only weakly statistically significant and only at the

median. This points to unions being important promoters of workers' rights among genders, i.e. among the workers themselves. This finding is in line with, e.g., Panagides and Patrinos (1994).

The last thing we will note is the higher importance of permanent contracts in the unionized sector as compared to the non-unionized sector, since the "permanent contract" indicator variable is positive and statistically significant at five percent for all quantiles (as well as OLS) in unionized firms, whereas it is only marginally significant (and negative) at the median only in the non-unionized sub-sample. Again, this points towards the unions being able to bargain on behalf of workers who have committed themselves (or been offered) to working for the firm in the long term, although they themselves are not able to achieve recognition due to the small size of the formal sector, and thus, resulting high competition among workers for formal sector jobs. To the union, also, it seems more fruitful to bargain on behalf of the more permanently attached workers, since they are the ones more likely to also work in the future, and, hence, to remain members of the union (and note that these findings occur despite the fact that most workers have a permanent contract, as discussed earlier).¹⁴

We also calculate the union premium; this is calculated as the difference in the (OLS) parameter estimates for the unionized and non-unionized sub-samples, evaluated at the mean of the full sample, following Booth (1995). We note that, in line with our previous discussion, there is a positive premium to women from being employed in the unionized sector (around five percent), as is also the case for permanently employed workers (around 85 percent). Lastly - referring to equation (8) above - evaluating the non-union sub-sample using the estimated union wage structure, i.e., "*as if*" it was unionized, further establishes the presence of structural differences between the union and non-union sections of the Ghanaian manufacturing industry in that for given characteristics, a worker in the union sector earns more than a worker in the non-union sector for "not unreasonable" levels of significance, i.e. above 7.5 percent.¹⁵ This finding

¹⁴ The cynic, however, may claim that the union in this case manages to obtain wage gains for its members, which are unwarranted in a productivity and/or efficiency sense, since most workers are on a permanent contract, anyway.

¹⁵ This conclusion is reached by performing a standard t-test for a null-hypothesis of equality between the estimated union wages and actual wages of non-union workers, with the alternative hypothesis being that the estimated wage is greater than the actual wage. The t-statistic is 1.445, which has a p-value of 0.075.

indicates the existence of structural differences between the union and non-unionized part of the manufacturing sector, i.e., that unions do affect wages positively, which is also in line with our previous findings. From the t-tests of equality of coefficients across quantiles in Appendix D, we note that the hypothesis of equal coefficients is rejected for several of the variables. Once again, this points towards the appropriateness of the quantile regression approach.

6. Conclusion

This paper analyzes the earnings determinants in Ghanaian manufacturing, focussing on the impact of unions and the possible asymmetries of this impact across the earnings distribution. The channels through which we conjecture a potential union effect are twofold. First, we propose a direct effect through individual union membership. This is the standard “union premium” well known from the empirical literature on unions. However, this does not take into account the possible spillover effects to wages of non-union members. To incorporate a potential spillover effect, we allow unionism to potentially affect all workers, including a sectoral union density variable. In addition, we examine whether there may be an additional union effect coming through via training, as proposed by, e.g., Booth and Chatterji (1998) and Booth, Zoega and Francesconi (1999), since the union may promote training to a degree over and above that of management, due to, for example, unions having a longer time horizon than management, which may merely maximize profits and stock values in the short term. We conjecture that the union effects are more likely to be present at the lower to medium quantiles of the earnings distribution, since unions are generally seen as – and increasingly perceive themselves as – proponents of workers’ rights and earnings mainly for the poorer part of workers. Such a view would also be in line with previous research, which generally finds that unions reduce income inequality and reduce wage discrimination, Panagides and Patrinos (1994).

While being of academic interest due to the relative skewness in earnings determinants studies since the majority of studies concern developed economies, and furthermore do so for the entire wage distribution, there are important policy issues

Note that while a two-sided test fails to reject equality, this does not take into account that we really are interested in the one-sided alternative, which, thus, is the one we use (and which also yields more power).

involved as well. Indeed, if unions affect wages positively, through the channels defined and discussed above, unions may promote a positive environment by affecting labor turnover and wage negotiation costs adversely, as well as promoting worker training, increased worker benefits and higher productivity, see Standing (1992).

The main finding of the paper is a finding of distinct asymmetries in the effects of unions across the wage distribution of workers. The findings are consistent with a prior belief that unions mainly bargain on behalf of the workers at the lower end of the wage distribution. Further, we find, in addition to a direct union premium related to individual union membership an additional spillover effect to non-union and union members alike, coming through via the degree of unionization of the sector. Lastly, we find an additional indirect union effect coming through via training, interpretable as unions either promoting training and/or being able to bargain and subsequently share some of the rents obtained by firms with their members. While unions generally have only a short and controversial history in Sub-Saharan Africa, due to the continent relying heavily on smallholder agriculture combined with unions often being prohibited, the findings of this study indicate a role for unions in Ghana as being an effective “voice” for workers, and, possibly, also as promoting training and efficiency in terms of lowering turnover and negotiation costs between workers and management (the data does not allow a rigorous investigation of this latter issue, however). Lastly, evaluating the non-union sub-sample using the estimated union wage structure, i.e., “*as if*” it was unionized, further establishes the presence of structural differences between the union and non-union part of the Ghanaian manufacturing industry in that, for given characteristics, a worker in the union sector earns more than a worker in the non-union sector. In combination, the sum of our findings implies the existence of structural differences between the union and non-unionized segments of the manufacturing sector, i.e., that unions do affect wages positively.

While this study establishes important channels through which unions affect wages of manufacturing workers in Ghana, further research is required to shed additional light on the economic effects of unions. Do unions generate the rents that are subsequently awarded to union members through increased wages via adversely affecting labor turnover, wage negotiation cost and increasing productivity, or do they merely act as a “voice” of the union members via their bargaining power, thus extracting already existing

rents from the firm, rents that the workers could not obtain a share of on their own? In particular, while some evidence seems to suggest that union workers are more productive than their non-union colleagues in manufacturing in general, see Sapsford and Tzannatos (1993), this has not, to our knowledge, been adequately investigated for the case of Ghana. This would be an interesting avenue for further research.

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Appendix A

Definitions of Variables

Log Wages:	Log monthly wages of individual
Age:	Age of individual
Age squared:	Age of individual squared
Female:	1 if female, zero otherwise
<i>Education:</i>	
Dummy variables for highest level of education completed of individual: 1 if as stated below, zero otherwise ("No completed education" is reference group):	
Primary:	Primary Education
Middle:	Middle Education
Secondary:	Secondary School
Vocational:	Vocational Education
Polytechnic:	Polytechnic or Technical Education
Professional:	Professional Education
University:	University
<i>Occupation:</i>	
Dummy variables for occupation of individual: 1 if as stated below, zero otherwise ("Production worker" is reference group):	
Administration:	Administrative Staff
Commercial:	Commercial and Sales Staff
Professional:	Professional Staff (Accountants, etc)
Support:	Support Staff
Manager:	Managerial Staff
Accra:	1 if Living in Accra, Zero otherwise
Firm Size:	log of the number of employees of the establishment
<i>Sector:</i>	
Dummy variables for sector of the firm: 1 if as stated below, zero otherwise ("Wood" is reference group):	
Metal:	Metals Sector
Textile:	Textile and Garments Sector
Food:	Food Sector
Tenure (years):	Years of tenure in the firm
Tenure squared:	Years of tenure in the firm squared
Training:	1 if the individual has been trained in the firm, zero otherwise
Tenure*training:	Interaction of Tenure and Training
Permanent:	1 if the worker has a permanent contract, zero otherwise
Permanent*training:	Interaction of Permanent and Training
Union density (sector): The fraction of the firms in sectors that have at least one organized worker	
Union density*Training:	Interaction of Union density and Training
Union membership: 1 if individual is member of a union, zero otherwise	
Union membership*Training: Interaction of Union membership and Training	

Appendix B

Mean Sample Characteristics

Variable	Full Sample (683 observations)		Non-Union Sub-sample (347 observations)		Union Sub-sample (336 observations)		Mann-Whitney Test Statistic
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Log wages	10.59	0.80	10.37	0.88	10.82	0.64	-9.327
Age	34.69	11.29	32.95	12.04	36.50	10.17	-5.746
Female	0.19	0.39	0.23	0.42	0.15	0.35	<u>2.826</u>
<i>Education:</i>							
Primary	0.03	0.17	0.05	0.22	0.01	0.09	<u>3.248</u>
Middle	0.49	0.50	0.54	0.50	0.44	0.50	2.724
Secondary	0.12	0.33	0.13	0.34	0.11	0.32	0.774
Vocational	0.13	0.33	0.08	0.27	0.17	0.38	-3.618
Polytechnic	0.09	0.28	0.06	0.23	0.12	0.33	<u>-3.103</u>
Professional	0.03	0.18	0.02	0.15	0.05	0.21	-1.562
University	0.02	0.12	0.01	0.09	0.02	0.14	-1.325
<i>Occupation:</i>							
Production worker	0.52	0.50	0.63	0.49	0.42	0.49	5.455
Administration	0.13	0.34	0.09	0.29	0.17	0.38	<u>-3.230</u>
Commercial	0.07	0.25	0.06	0.23	0.08	0.27	-1.029
Professional	0.04	0.20	0.03	0.18	0.05	0.21	-1.067
Support	0.12	0.33	0.12	0.32	0.13	0.34	-0.508
Manager	0.12	0.32	0.08	0.27	0.16	0.37	<u>-3.111</u>
Accra	0.62	0.49	0.58	0.50	0.66	0.48	<u>-2.185</u>
Firm Size	3.74	1.19	3.18	1.14	4.31	0.94	-13.335
Wood	0.14	0.35	0.18	0.38	0.11	0.31	<u>2.568</u>
Metal	0.32	0.47	0.29	0.46	0.35	0.48	-1.518
Textile	0.27	0.44	0.23	0.42	0.30	0.46	<u>-2.072</u>
Food	0.27	0.45	0.30	0.46	0.24	0.43	1.633
Tenure (years)	6.61	6.64	5.26	6.01	8.00	6.98	-6.294
Permanent	0.98	0.15	0.97	0.18	0.99	0.09	<u>-2.285</u>
Training	0.31	0.46	0.39	0.49	0.23	0.42	4.436
Union membership	0.30	0.46	0.00	0.00	0.60	0.49	--

Notes: The Mann-Whitney test is a test of equality of the distributions of the variable in question between union and non-union subsamples. **Bold:** Statistically significant at 1 percent; underline: Statistically significant at 5 percent; *cursive:* Statistically significant at 10 percent.
Source: Authors' calculations from RPED III for Ghana (1994).

Appendix C1

Quantile and OLS Earnings Results for Full Sample

Variable	Quantile Regressions						OLS	
	0.10		0.50		0.90			
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
Age	0.022	0.015	<i>0.030</i>	<i>0.018</i>	0.020	0.019	0.036	0.014
Age squared	-0.000	0.000	-0.000	0.000	-0.000	0.000	<u>-0.000</u>	<u>0.000</u>
Female	-0.029	0.093	-0.216	0.067	<i>-0.246</i>	<i>0.133</i>	<i>-0.116</i>	<i>0.069</i>
<i>Education:</i>								
Primary	-0.188	0.214	0.203	0.264	0.647	0.580	0.441	0.161
Middle	0.036	0.145	0.046	0.102	<i>0.208</i>	<i>0.111</i>	0.234	0.090
Secondary	0.040	0.169	0.097	0.101	0.496	0.182	0.336	0.115
Vocational	0.021	0.200	<u>0.227</u>	<u>0.097</u>	<u>0.369</u>	<u>0.180</u>	0.383	0.115
Polytechnic	0.286	0.188	0.348	0.106	0.686	0.180	0.553	0.124
Professional	<u>0.440</u>	<u>0.221</u>	0.765	0.216	0.798	0.226	0.796	0.173
University	0.574	0.469	1.004	0.345	1.597	0.412	1.251	0.236
<i>Occupation:</i>								
Administration	<i>0.204</i>	<i>0.119</i>	0.273	0.064	<u>0.394</u>	<u>0.180</u>	<u>0.197</u>	<u>0.085</u>
Commercial	0.198	0.121	<i>0.162</i>	<i>0.094</i>	<u>0.329</u>	<u>0.144</u>	<u>0.252</u>	<u>0.104</u>
Professional	0.777	0.154	0.582	0.202	<u>0.509</u>	<u>0.256</u>	0.459	0.147
Support	-0.055	0.122	<u>-0.143</u>	<u>0.062</u>	-0.137	0.107	-0.220	0.081
Manager	0.347	0.096	0.388	0.102	0.574	0.169	0.391	0.088
Accra	0.213	0.080	0.079	0.050	0.004	0.084	-0.010	0.053
Firm Size	0.124	0.034	0.110	0.027	0.126	0.046	0.126	0.024
Tenure (years)	0.021	0.018	0.014	0.011	0.006	0.025	-0.010	0.011
Tenure squared	-0.001	0.001	-0.000	0.001	0.000	0.002	<i>0.001</i>	<i>0.000</i>
Tenure*training	-0.002	0.013	-0.000	0.008	-0.000	0.014	-0.002	0.009
Permanent	0.359	0.302	-0.367	0.291	-0.117	0.149	-0.004	0.219
Permanent*training	-0.436	0.386	<i>0.596</i>	<i>0.357</i>	0.650	0.239	0.150	0.3427
Training	-0.070	0.389	<u>-0.821</u>	<u>0.353</u>	-0.843	0.265	-0.386	0.340
Union density (sector)	-0.245	0.705	0.575	0.549	0.384	1.161	0.386	0.546
Union density*	0.739	0.257	0.656	0.205	<i>0.642</i>	<i>0.358</i>	<u>0.505</u>	<u>0.210</u>
Training								
Union membership	<u>0.156</u>	<u>0.078</u>	0.071	0.049	-0.051	0.114	0.014	0.068
Union membership*	<u>0.427</u>	<u>0.174</u>	0.122	0.090	0.028	0.169	0.150	0.126
Training								
Constant	8.394	0.436	9.254	0.394	9.628	0.551	8.766	0.368
R ²	0.36		0.32		0.33		0.39	

Note: Number of observations = 683, R² is pseudo-R² for the quantile regressions and adjusted R² for the OLS-regression, OLS-regression: F(27, 655) = 17.4, Prob > F = 0.000. The educational reference group is "no completed education". The occupational reference category is "production worker". **Bold:** Statistically significant at 1 percent; underline: Statistically significant at 5 percent; *cursive:* Statistically significant at 10 percent.

Source: Regional Program on Enterprise Development for Ghana (Wave III, 1994).

Appendix C2

Quantile and OLS Earnings Results for *Non-unionized Firms Only*

Variable	Quantile Regressions						OLS	
	0.10		0.50		0.90			
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
Age	0.014	0.030	<i>0.048</i>	<i>0.029</i>	0.037	0.034	0.025	0.021
Age squared	-8.8e-5	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000
Female	<u>-0.337</u>	<u>0.135</u>	<u>-0.254</u>	<u>0.117</u>	-0.306	0.256	<u>-0.280</u>	<u>0.114</u>
<i>Education:</i>								
Primary	0.229	0.319	<u>0.579</u>	<u>0.265</u>	<i>1.229</i>	<i>0.656</i>	<u>0.480</u>	<u>0.218</u>
Middle	0.192	0.219	0.013	0.108	0.265	0.172	<i>0.269</i>	<i>0.141</i>
Secondary	0.028	0.263	-0.062	0.203	0.204	0.212	0.116	0.184
Vocational	0.257	0.310	0.117	0.162	0.372	0.576	<u>0.467</u>	<u>0.194</u>
Polytechnic	0.412	0.425	0.208	0.211	<u>0.733</u>	<u>0.309</u>	<u>0.474</u>	<u>0.227</u>
Professional	<u>0.874</u>	<u>0.395</u>	0.401	0.342	<u>1.641</u>	<u>0.704</u>	<u>0.823</u>	<u>0.340</u>
University	<i>1.285</i>	<i>0.706</i>	1.185	0.767	2.025	0.760	1.635	0.475
<i>Occupation:</i>								
Administration	<u>0.557</u>	<u>0.262</u>	0.498	0.170	0.575	0.387	0.603	0.168
Commercial	0.619	0.197	<u>0.268</u>	<u>0.129</u>	0.018	0.259	<u>0.487</u>	<u>0.190</u>
Professional	<i>0.706</i>	<i>0.380</i>	<i>0.867</i>	<i>0.476</i>	-0.387	0.928	0.448	0.293
Support	-0.083	0.227	-0.092	0.141	-0.474	0.145	<u>-0.338</u>	<u>0.138</u>
Manager	0.507	0.165	0.481	0.149	0.079	0.215	<u>0.368</u>	<u>0.159</u>
Accra	0.197	0.155	0.108	0.097	0.190	0.152	0.004	0.090
Firm Size	0.161	0.052	0.065	0.043	0.050	0.077	<i>0.079</i>	<i>0.041</i>
Metal	0.013	0.187	<i>0.206</i>	<i>0.112</i>	-0.309	0.376	-0.09	0.132
Textile	0.235	0.162	0.280	0.095	-0.053	0.339	0.139	0.129
Food	0.009	0.150	0.158	0.132	-0.084	0.363	0.103	0.130
Tenure (years)	-0.009	0.034	-0.016	0.023	-0.067	0.062	-0.023	0.022
Tenure squared	0.001	0.001	0.001	0.001	<i>0.007</i>	<i>0.004</i>	<u>0.002</u>	<u>0.001</u>
Tenure*training	-0.008	0.028	0.008	0.015	0.023	0.057	0.001	0.018
Permanent	0.137	0.366	-0.213	0.183	0.234	0.251	-0.069	0.292
Permanent*	-0.215	0.455	0.241	0.345	0.441	0.416	0.438	0.448
Training								
Training	0.079	0.448	-0.434	0.326	<i>-0.708</i>	<i>0.423</i>	-0.548	0.443
Constant	8.384	0.679	9.149	0.532	9.649	.676	9.316	0.487
R ²	0.35		0.30		0.31		0.33	

Note: Number of observations = 347, R² is pseudo-R² for the quantile regressions and adjusted R² for the OLS-regression, OLS-regression: F(26, 320) = 7.51, Prob > F = 0.000. The educational reference group is "no completed education". The occupational reference category is "production worker". **Bold**: Statistically significant at 1 percent; underline: Statistically significant at 5 percent; *cursive*: Statistically significant at 10 percent.

Source: Regional Program on Enterprise Development for Ghana (Wave III, 1994).

Appendix C3

Quantile and OLS Earnings Results for Unionized Firms Only

Variable	Quantile Regressions						OLS		Marginal Contribution (OLS) $(\beta_u - \beta_n)\bar{X}$
	0.10		0.50		0.90		Coeff.	Std.err.	
Age	<u>0.074</u>	<u>0.037</u>	0.034	0.028	0.033	0.025	0.051	0.017	0.902
Age squared	<i>-0.001</i>	<i>0.001</i>	-0.000	0.000	-0.000	0.000	<u>-0.001</u>	<u>0.000</u>	-1.331
Female	0.052	0.134	<i>-0.193</i>	<i>0.099</i>	-0.147	0.130	-0.033	0.086	0.047
<i>Education:</i>									
Primary	0.121	0.401	0.268	0.414	0.046	0.442	-0.017	0.309	-0.015
Middle	0.138	0.198	<i>0.205</i>	<i>0.114</i>	0.330	0.107	<u>0.239</u>	<u>0.111</u>	-0.015
Secondary	<i>0.383</i>	<i>0.231</i>	0.485	0.154	0.955	0.298	0.574	0.140	0.056
Vocational	0.331	0.261	0.425	0.150	0.453	0.146	0.377	0.132	-0.011
Polytechnic	<i>0.474</i>	<i>0.244</i>	0.492	0.141	0.704	0.210	0.592	0.137	0.010
Professional	<i>0.581</i>	<i>0.306</i>	1.103	0.290	1.149	0.259	0.837	0.175	0.001
University	0.079	0.567	<u>1.220</u>	<u>0.490</u>	1.905	0.519	1.129	0.232	-0.007
<i>Occupation:</i>									
Administration	0.102	0.178	0.104	0.092	<i>0.330</i>	<i>0.171</i>	0.117	0.090	-0.063
Commercial	0.243	0.206	<i>0.210</i>	<i>0.118</i>	<u>0.282</u>	<u>0.140</u>	0.164	0.110	-0.022
Professional	0.647	0.203	<i>0.349</i>	<i>0.202</i>	<u>0.645</u>	<u>0.272</u>	0.448	0.151	0.000
Support	-0.070	0.132	0.082	0.085	0.118	0.128	-0.001	0.090	0.041
Manager	<i>0.329</i>	<i>0.184</i>	<u>0.349</u>	<u>0.148</u>	0.655	0.187	0.463	0.096	0.011
Accra	0.124	0.172	0.037	0.086	<i>0.175</i>	<i>0.106</i>	0.056	0.072	0.032
Firm Size	0.068	0.055	0.146	0.038	<i>0.083</i>	<i>0.046</i>	0.114	0.034	0.131
Metal	0.190	0.258	<i>0.163</i>	<i>0.089</i>	<u>0.300</u>	<u>0.130</u>	<u>0.238</u>	<u>0.102</u>	0.105
Textile	0.060	0.252	0.095	0.112	<u>0.449</u>	<u>0.193</u>	0.179	0.113	0.011
Food	0.106	0.305	<u>0.211</u>	<u>0.105</u>	<u>0.384</u>	<u>0.161</u>	<u>0.235</u>	<u>0.117</u>	0.036
Tenure (years)	0.002	0.025	0.015	0.016	-0.000	0.020	0.005	0.013	0.185
Tenure squared	-0.000	0.001	-0.000	0.001	0.000	0.001	-3.5e-5	0.001	-0.179
Tenure*training	0.018	0.015	0.006	0.011	0.000	0.013	0.005	0.009	0.008
Permanent	<i>0.473</i>	<i>0.284</i>	0.535	0.255	1.484	0.511	<u>0.804</u>	<u>0.361</u>	0.854
Permanent*training	<i>-0.786</i>	<i>0.436</i>	<u>-0.227</u>	<u>0.266</u>	-0.523	0.424	-0.538	0.610	-0.293
Training	<i>0.707</i>	<i>0.392</i>	<i>0.170</i>	<i>0.254</i>	0.500	0.401	0.498	0.607	0.323
Constant	7.504	0.703	8.243	0.526	7.514	0.688	7.626	0.501	-1.690

Note: Number of observations = 336, R^2 is pseudo- R^2 for the quantile regressions and adjusted R^2 for the OLS-regression, OLS-regression: $F(26, 309) = 10.46$, $\text{Prob} > F = 0.000$. The educational reference group is "no completed education". The occupational reference category is "production worker". **Bold**: Statistically significant at 1 percent; underline: Statistically significant at 5 percent; *cursive*: Statistically significant at 10 percent.

Source: Regional Program on Enterprise Development for Ghana (Wave III, 1994).

Appendix D

Test of Equality of Coefficients Across Quantiles

Variable/Quantile	Full Sample			Non-Union Subsample			Union Subsample		
	Q _{0.1} /Q _{0.5}	Q _{0.1} /Q _{0.9}	Q _{0.5} /Q _{0.9}	Q _{0.1} /Q _{0.5}	Q _{0.1} /Q _{0.9}	Q _{0.5} /Q _{0.9}	Q _{0.1} /Q _{0.5}	Q _{0.1} /Q _{0.9}	Q _{0.5} /Q _{0.9}
Age	0.14	0.01	0.20	1.06	0.36	0.10	<i>1.30</i>	0.98	0.00
Age squared	0.01	0.18	0.12	1.05	0.37	0.13	1.17	1.23	0.05
Female	2.93	<u>1.99</u>	0.05	0.28	0.01	0.05	3.35	1.29	0.10
<i>Education:</i>									
Primary	<u>1.75</u>	<u>1.87</u>	0.64	0.94	<u>1.88</u>	1.10	0.10	0.02	0.31
Middle	0.00	0.91	<u>1.79</u>	0.69	0.07	<u>1.84</u>	0.13	0.90	0.87
Secondary	0.10	3.48	4.21	0.09	0.30	1.09	0.19	2.61	<u>2.28</u>
Vocational	1.09	1.59	0.63	0.20	0.03	0.21	0.12	0.19	0.03
Polytechnic	0.10	2.60	3.37	0.27	0.41	2.61	0.01	0.62	0.83
Professional	1.47	1.29	0.01	1.27	0.95	2.89	<u>1.89</u>	<u>2.32</u>	0.03
University	0.79	2.72	<u>1.71</u>	0.02	0.70	<i>1.39</i>	3.67	5.86	<i>1.57</i>
<i>Occupation:</i>									
Administration	0.38	0.88	0.47	0.00	0.05	0.04	0.00	0.97	<u>1.77</u>
Commercial	0.07	0.56	1.23	2.54	3.36	1.05	0.03	0.03	0.21
Professional	0.88	0.90	0.07	0.10	1.19	<u>1.73</u>	<i>1.39</i>	0.00	1.06
Support	0.52	0.29	0.00	0.00	<u>2.08</u>	4.44	1.24	1.13	0.07
Manager	0.11	<i>1.58</i>	1.22	0.02	2.82	2.98	0.01	<u>1.68</u>	<u>2.20</u>
Accra	<u>2.34</u>	3.53	0.75	0.33	0.00	0.28	0.30	0.07	<i>1.40</i>
Firm Size	0.15	0.00	0.13	2.83	<i>1.62</i>	0.04	<u>1.81</u>	0.05	<i>1.49</i>
Metal	-	-	-	0.95	0.61	<u>1.88</u>	0.01	0.16	0.89
Textile	-	-	-	0.08	0.64	1.02	0.02	<i>1.59</i>	3.02
Food	-	-	-	0.77	0.06	0.42	0.12	0.66	0.99
Tenure (years)	0.12	0.22	0.09	0.04	0.68	0.77	0.23	0.01	0.50
Tenure squared	0.26	0.18	0.05	0.00	2.62	3.06	0.08	0.20	0.12
Tenure*training	0.01	0.01	0.00	0.25	0.19	0.06	0.58	0.91	0.17
Permanent	3.94	<u>1.99</u>	0.73	0.89	0.06	2.75	2.35	4.59	2.60
Permanent*Training	5.70	6.35	0.02	0.85	1.27	0.19	0.58	0.43	0.00
Training	2.96	2.97	0.00	1.12	<u>1.78</u>	0.39	0.67	0.36	0.00
Union density	1.23	0.23	0.03	-	-	-	-	-	-
(sector)									
Union density*	0.11	0.07	0.00	-	-	-	-	-	-
Training									
Union membership	1.08	2.53	1.24	-	-	-	-	-	-
Union membership*	3.08	3.10	0.29	-	-	-	-	-	-
Training									
Constant	2.95	3.45	0.48	1.02	<u>2.02</u>	0.49	0.34	0.00	0.38

Note: Tests are one-sided t-tests, H_0 : coefficient(Q_i) = coefficient(Q_j), $i,j=0.1, 0.5, 0.9$; **Bold:** Statistically significant at 1 percent; underline: Statistically significant at 5 percent; *cursive:* Statistically significant at 10 percent.

Source: Regional Program on Enterprise Development for Ghana (Wave III, 1994).

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